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HYGIENIC LABORATORY.—BULLETIN No. 15.

M. J. ROSENAU, Director.

July, 1903.

Biological & Medical Serials

INEFFICIENCY OF FERROUS SULPHATE AS AN ANTISEPTIC AND GERMICIDE.

BY

ALLAN J. McLAUGHLIN.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1903.

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The Hygienic Laboratory was established in New York, at the Marine Hospital on Staten Island, August, 1887. It was transferred to Washington, with quarters in the Butler Building, June 11, 1891, and a new laboratory building, to be located in Washington, was authorized by act of Congress, March 3, 1901.

The following *bulletins* [Bull. Nos. 1-7, 1900 to 1902, Hyg. Lab., U. S. Mar.-Hosp. Serv., Wash.] have been issued:

No. 1.—Preliminary note on the viability of the *Bacillus pestis.* By M. J. Rosenau.

No. 2.—Formalin disinfection of baggage without apparatus. By M. J. Rosenau.

No. 3.—Sulphur dioxide as a germicidal agent. By H. D. Geddings.

No. 4.—Viability of the *Bacillus pestis.* By M. J. Rosenau.

No. 5.—An investigation of a pathogenic microbe (*B. typhi murium* Danyz) applied to the destruction of rats. By M. J. Rosenau.

No. 6.—Disinfection against mosquitoes with formaldehyd and sulphur dioxid. By M. J. Rosenau.

No. 7.—Laboratory technique: Ring test for indol, by S. B. Grubbs and Edward Francis; Collodium sacs, by S. B. Grubbs and Edward Francis; Microphotography with simple apparatus, by H. B. Parker.

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No. 8.—Laboratory course in bacteriology and pathology. By M. J. Rosenau.

No. 9.—Presence of tetanus in commercial gelatin. By John F. Anderson.

No. 10.—Report upon the prevalence and geographic distribution of hookworm disease (uncinariasis or anchylostomiasis) in the United States. By Ch. Wardell Stiles.

No. 11.—Experimental investigation of *Trypanosoma Lewisi.* By Edward Francis.

No. 12.—The bacteriological impurities of vaccine virus; an experimental study. By M. J. Rosenau.

No. 13.—A statistical study of the intestinal parasites of 500 white male patients at the United States Government Hospital for the Insane; by Philip E. Garrison, Brayton H. Ransom, and Earle C. Stevenson. A parasitic roundworm (*Agamomermis culicis* n. g., n. sp.) in American mosquitoes (*Culex sollicitans*); by Ch. Wardell Stiles. The type species of the cestode genus *Hymenolepis;* by Ch. Wardell Stiles.

No. 14.—Spotted fever (tick fever) of the Rocky Mountains; a new disease. By John F. Anderson.

No. 15.—Inefficiency of ferrous sulphate as an antiseptic and germicide. By Allan J. McLaughlin.

In citing these bulletins, beginning with No. 8, bibliographers and authors are requested to adopt the following abbreviations: Bull. No. ——, Hyg. Lab., U. S. Pub. Health & Mar.-Hosp. Serv., Wash., pp. ——.

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Walter Wyman, *Surgeon-General,*
United States Public Health and Marine-Hospital Service.

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INEFFICIENCY OF FERROUS SULPHATE AS AN ANTISEPTIC AND GERMICIDE.

By Allan J. McLaughlin,
Assistant Surgeon, Public Health and Marine-Hospital Service.

Ferrous sulphate, green sulphate of iron, green vitriol, or copperas, are the various names of a chemical substance that has long been used extensively for the disinfection of animal excreta. It has been popular among the laity because of its cheapness and ease of application as a disinfectant and deodorant for privy vaults, etc. It has official recognition in the French army as a disinfectant for latrines. The literature upon the subject is scanty and in some instances contradictory.

Chevalier reviewed a paper by Schattenman, read before the Paris Academy of Sciences in 1846, in which Schattenman set forth that 2 or 3 kilograms of ferrous sulphate were necessary to disinfect 100 liters of fecal matter. He laid stress on the fact that an intimate mixture must be made of the fecal matter and ferrous sulphate solution.

Koch found that a 5 per cent solution failed to destroy anthrax spores in six days.

Miquel classes ferrous sulphate as a moderately antiseptic substance. A proportion of 1:90 was required to restrain putrefaction.

Rideal says:

> The sulphates are not perceptibly antiseptic. Those of iron, mercury, and some other metals depend for their power on the amount of the base present, and not on the acid.

Bergey says:

> It [ferrous sulphate] is not a strong disinfectant, but it is serviceable as a deodorant. It should be used in the proportion of 1 kilogram (dissolved in 10 liters of water) to a cubic meter of the contents of the vault.

Munson says:

> The properties of ferrous sulphate which render it useful for purposes of disinfection depend upon its tendency to appropriate oxygen and so become converted into the ferric sulphate. These qualities, however, must be considered as antiseptic rather than disinfectant, since, according to Laveran, the addition of even 5 or 6 per cent of the salt to fecal matter is unable uniformly to affect the sterilization of the latter. Sulphate of iron is used only in solution, the amount of the iron salt to be daily employed depending upon the estimated increment of the fresh fecal matter rather than upon any particular strength of the solution. Should the contents of the latrine be semifluid, the solution of sulphate of iron may with advantage be made up with but a small proportion of water, since for efficiency a high proportion of

ferrous sulphate should be brought into direct contact with the excreta. In practice, a proportion of five parts of the iron salt in each hundred of the total contents of the latrine vault should be considered as essential to efficiency. In the French army ferrous sulphate is much used for the disinfection of latrines in a 10 per cent solution. It is officially laid down that at least 250 c. c. of such a solution should be used per day for each person using the latrine.

Sternberg found that a solution of 20 per cent failed to destroy micrococci and putrefactive bacteria (1883). Later he found that 10 per cent failed to kill pus cocci, but was fatal to micrococcus tetragenous—two hours' exposure. He also found that 1:200 prevented the development of micrococci and of putrefactive bacteria in bouillon placed in the incubator for forty-eight hours.

Jäger[a] found that a solution of 1:3 destroyed the infective virulence of some pathogenic organisms (fowl cholera, rothlauf, glanders), as tested by injection into mice, but failed to kill anthrax spores and tubercle bacilli.

Leitz[a] found that a 5 per cent solution required three days' exposure for the destruction of the typhoid bacillus.

In a series of experiments bearing upon the disinfection of feces, Foote mixed decomposing urine with feces, 1 part feces to two-thirds of its bulk of urine. Five hundred c. c. of the disinfectant mixture (ferrous sulphate ℥ xviii, water 1 gallon) was added to 250 c. c. of the feces-urine mixture and the two thoroughly mixed. Inoculations of one platinum loopful were made from the mixture into gelatin and bouillon after one hour, four hours, and forty-eight hours of action. The sulphate of iron solution had little if any effect. Even after forty-eight hours' action the colonies upon the gelatin plates were innumerable and a profuse growth appeared in the bouillon tubes.

In order to ascertain the antiseptic and disinfectant value of ferrous sulphate a number of experiments were carried out with the results shown in the following tables:

ANTISEPTIC POWER OF FERROUS SULPHATE.

Table I.

Bouillon with the addition of ferrous sulphate in various percentages contaminated by the addition of a small quantity of garden earth. Kept at room temperature.

Proportion of ferrous sulphate.	First day.	Second day.	Third day.	Tenth day.	Twenty-first day.
1:200	Very foul odor				
1:150	do				
1·100	do				
1:50	Foul odor	Very foul odor			
1:40	No odor	No odor	Foul odor		
1:30	do	do	do		
1:25	do	do	No odor	Faint odor	Foul odor.
1:20	do	do	do	No odor	No odor.
1:15	do	do	do	do	Do.
1.10	do	do	do	do	Do.
1.5	do	do	do	do	Do.

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[a] Cited by Sternberg.

Table II.

Bouillon with the addition of ferrous sulphate in various percentages contaminated by the addition of a small quantity of garden earth. Kept in the incubator.

Proportion of ferrous sulphate.	First day.	Second day.	Third day.	Fifth day.	Fourteenth day.
1:200	Very foul odor				
1:150	Foul odor				
1:100	do				
1:50	No odor	Foul odor			
1:35	do	do			
1:30	do	do			
1:28	do	No odor	Foul odor		
1:25	do	do	No odor	Foul odor	
1:23	do	do	do	do	
1:20	do	do	do	No odor	No odor.

GERMICIDAL ACTION OF FERROUS SULPHATE.

Forty-eight hour bouillon cultures of B. typhosus, B. coli communis, B. pyocyaneus, vibrio cholera Asiat., strong aqueous suspensions from forty-eight hour cultures on agar of B. anthracis, B. subtilis, Staphyl. pyog. aureus and albus, and a strong suspension of a forty-eight hour growth of B. diphtheria on blood serum were used to contaminate slips of filter paper, silk threads, and glass cover slips. After being contaminated by the culture the paper slips, silk thread and cover slips were placed in the incubator until they were almost dry (in the case of anthrax and subtilis they were allowed to dry completely), then the disinfecting agent was applied for definite periods, its action stopped by careful washing in sterile water, the slips and threads planted in bouillon and placed in the incubator for forty-eight hours.

Table III.—*Infected material, filter paper.*

Organism employed.	Result after application of sat. sol. of ferrous sulphate.					
	5 minutes.	10 minutes.	20 minutes.	30 minutes.	45 minutes.	60 minutes.
B. anthracis	+	+	+	+	+	+
B. subtilis	+	+	+	+	+	+
B. typhosus	+	+	+	+	+	−
B. coli communis	+	+	+	+	+	+
B. pyocyaneus	+	+	+	+	+	+
Vib. cholera Asiat	+	+	+	+	+	+
B. diphtheria	+	+	+	+	+	+
Staphyl. pyog. aureus	+	+	+	+	+	+
Staphyl. epider. albus	+	+	+	+	+	+

Table IV.—*Infected material, silk threads.*

Organism employed.	Result after application of saturated solution of ferrous sulphate.					
	5 minutes.	10 minutes.	20 minutes.	30 minutes.	45 minutes.	60 minutes.
B. anthracis	+	+	+	+	+	+
B. subtilis	+	+	+	+	+	+
B. typhosus	+	+	+	+	+	
B. coli communis	+	+	+	+	+	+
B. pyocyaneus	+	+	+	+	+	+
B. diphtheriæ	+	+	+	+	+	+
Vibrio cholera Asiat	+	+	+	+	+	+
Staphyl. pyogenes aureus	+	+	+	+	+	+
Staphyl. epider. albus	+	+	+	+	+	+

TABLE V.—*Infected material, glass cover slips.*

Organism employed.	Result after application of saturated solution of ferrous sulphate.					
	5 minutes.	10 minutes.	20 minutes.	30 minutes.	45 minutes.	60 minutes.
B. anthracis	+	+	+	+	+	+
B. subtilis	+	+	+	+	+	+
B. typhosus	+	+	+	+	+	—
B. coli communis	+	+	+	+	+	+
B. pyocyaneus	+	+	+	+	+	+
B. diphtheriæ	+	+	+	+	+	+
Vibrio cholera Asiat	+	+	+	+	+	—
Staphyl. pyogenes aureus	+	+	+	+	+	+
Staphyl. epider. albus	+	+	+	+	+	+

Some of the pathogenic organisms tested (V. choleræ and B. typhosus) did not grow after one hour exposure to the iron solution; but in the following experiments upon feces it will be seen that V. choleræ was recovered from feces after forty-eight hours exposure to a saturated solution. In the experiments upon feces the saturated solution of ferrous sulphate constituted twice the bulk of the feces and was intimately mixed with it, and all lumps broken up to make as nearly as possible a homogeneous mixture.

TABLE VI.

Twenty-five grams of feces thoroughly mixed with twice its bulk (50 c. c.) of a saturated solution of ferrous sulphate. At definite intervals a platinum wire loopful was planted in bouillon and placed in the incubator twenty-four hours, with the results given below.

Time of exposure to iron solution.	Result.
5 minutes	Good growth.
10 minutes	Do.
20 minutes	Do.
30 minutes	Do.
40 minutes	Do.
50 minutes	Do.
1 hour	Do.
2 hours	Do.
18 hours	Do.
24 hours	Do.
48 hours	Do.
72 hours	Do.

TABLE VII.

Twenty-five grams feces thinned by the addition of 10 c. c. bouillon culture of pyocyaneus and thoroughly mixed with twice its bulk of a saturated solution of ferrous sulphate. A platinum wire loopful of the mixture was planted at definite intervals in bouillon and placed in the incubator for twenty-four hours, with the result indicated below.

Time of exposure to iron solution.	Result.
1 hour	Good growth. B. pyocyaneus recovered.
2 hours	Do.
3 hours	Do.
4 hours	Do.
5 hours	Do.
6 hours	Do.
24 hours	Do.
48 hours	Do.
72 hours	Do.

Table VIII.

A mixture of feces, thinned by the addition of 10 c. c. of a twenty-four-hour bouillon culture of Vibrio choleræ Asiat. and mixed with twice its bulk of a saturated solution of ferrous sulphate, was tested at stated intervals by taking out a platinum wire loopful and planting in bouillon. The results are indicated below.

Time of exposure to iron solution.	Result.
6 hours	Good growth. V. choleræ recovered.
24 hours	Do.
26 hours	Do.
28 hours	Do.
30 hours	Do.
48 hours	Do.

Sulphate of iron does not show any restraining influence over the development of putrefactive changes unless it constitutes more than 2 per cent of the mixture. It does not permanently restrain the development of putrefactive changes unless it constitutes at least 5 per cent of the mixture.

As a germicide it has little or no action, even when applied under the most favorable conditions for disinfection. Where the material to be disinfected was flooded with the agent in saturated solution, in nearly all experiments, its action was not apparent, and it failed to disinfect under such favorable conditions seven different varieties of pathogenic organisms out of nine, after an exposure of one hour to a saturated solution.

Tested upon feces it failed to disinfect after three days, although intimately mixed with the feces, and when it was applied in saturated solution and in double the bulk of the material to be disinfected.

It seems therefore that copperas or sulphate of iron is of no real value as a disinfectant. The strongest solution has either no disinfectant action at all, or its disinfectant action is so slow and uncertain that its demonstration might be a matter of interest, but certainly could not be of practical value.

REFERENCES.

A. Chevalier. Revue de Therapeutique Medico-Chirurgical, Paris, 1862, X, p. 456–458.

Robert Koch. Ueber Disinfektion. Mittheilungen aus dem Kaiserlichen Gesundheitsamte, bd. I, 1881, article no. 7.

Miquel. L'Annuaire de Montsouris for the year 1884. (Reviewed in Bulletin de Therapeutique, 1884, no. 107, p. 80.)

Samuel Rideal. Disinfection and Disinfectants, London, 1898, p. 98.

D. H. Bergey. The Principles of Hygiene, Philadelphia and London, 1901, p. 282.

Edward L. Munson. The Theory and Practice of Military Hygiene, New York, 1901, p. 782.

George M. Sternberg. A Text-book of Bacteriology, New York, 1901, p. 189–190.

Charles J. Foote. The American Journal of the Medical Sciences, October, 1889, XCVIII, p. 329.

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